Continuing successful eradication of parthenium weed (*Parthenium hysterophorus*) from New South Wales, Australia

Philip J. Blackmore[1] and Stephen B. Johnson[2]
Invasive Species Unit, Biosecurity, New South Wales Department of Industry and Investment,
[1] PO Box U86, University of New England, Armidale, NSW 2351, Australia
[2] Locked Bag 21, Orange, NSW 2800, Australia
Corresponding author: stephen.johnson@industry.nsw.gov.au

Summary This paper details aspects of the continued successful eradication of parthenium weed from New South Wales (NSW). Parthenium weed is one of the 20 Australian Weeds of National Significance and is increasingly problematic in central and southern Queensland (Qld). The species decreases the viability of livestock production, harbours plant disease, and causes health problems in humans. Parthenium weed was first detected in NSW in 1982. Since that time there have been numerous detections (usually small numbers of plants) and subsequent eradications. Strong legislative, extension and management processes have supported this eradication program. The state of NSW covers in excess of 800,000 km^2. There are no geographic or artificial borders stopping the spread of any weed between NSW and Qld. On the contrary, there are many opportunities for weed seed spread between the two states, both via natural means and via vehicular and harvest machinery movement. This simple fact highlights the remarkable success of the NSW parthenium eradication campaign. It also highlights that containment of weeds to one area of a contiguous land mass, and eradication from other areas is possible. The factors responsible for this success are examined and discussed.

Keywords Dispersal, cereal production, roadside, inspection, hygiene.

INTRODUCTION

Parthenium weed (*Parthenium hysterophorus* L., Asteraceae) is a vigorous, branched herb that can grow to 2 m high (Navie *et al.* 1996). It is a prolific seed producer that easily spreads and colonises new areas, quickly becoming dominant or forming monocultures. As such it reduces pasture productivity and livestock production, as well as being a contaminant of produce, thereby restricting sale and movement. Parthenium weed is toxic to grazing animals, an alternate host of plant pathogens, an environmental weed and causes various allergenic reactions in humans, for example dermatitis, hay fever and asthma (Chamberlain and Gittens 2003).

The species was first introduced into Australia in the Brisbane Valley via contaminated machinery during the Second World War (reported in 1955), and then separately introduced into central Queensland (Qld) in 1958 as a contaminant of pasture seed (reported in 1964). Parthenium weed was only recognised as a serious threat in 1973 with legislative restrictions imposed in Qld in 1975 (Navie *et al.* 1996, Parsons and Cuthbertson 2001). In contrast, the first infestations of parthenium weed were found in April 1982 (near Narrabri) in north western New South Wales (Blackmore 1997), not 1980 near Wellington as erroneously claimed by Parsons and Cuthbertson (2001). Within the next 12 months a further 300 plants were found in 17 other locations, based largely in the Narrabri and Moree Plains local government areas. This count does not include two infestations of approximately 3 ha (heavily infested) and 1000 ha (scattered plants) on adjoining properties under the same ownership in this period. These outbreaks demonstrated the threat posed by parthenium weed to NSW. Parthenium weed is now widely spread throughout central Qld and it continues to encroach on southern Qld (Weeds Australia 2010) but has not yet established in NSW.

This paper reports on the continued successful eradication of parthenium weed incursions in NSW. We have defined continued successful eradication as the annual detection and successful treatment of infestations. To ensure eradication, these infestations were inspected annually for a variable number of subsequent years. Infestations were defined as recurring if recruitment occurred from the seed bank (from plants that were previously discovered after seeding). We examined the rate of parthenium weed detections (from new and recurring infestations) and the number of new infestation sites to ascertain if management was successful. We also report on the probable dispersal mechanisms and seasonality of detection of infestations to assess the risk of various dispersal pathways and to provide guidance on the best ways to prevent further movement.

METHODS

Data from 777 recorded infestations in NSW from the period 1982–2009 (28 years) were examined. Each record contained the date, latitude and longitude, the

land use the infestation was found in and a general description of the infestation. In most cases the exact number of plants found and treated was recorded, except in cases of large infestations (generally >1000 plants) or scattered infestations over large areas, for example 1000 ha. In a small number of cases (10), the number of plants used in the analysis was the minimum number recorded, so for >1000 plants, 1000 plants was used. As such, the total number of plants reported in Figures 1 and 2 represent absolute minima. Data were also classified as new or recurring infestations.

Data relating to the probable source of parthenium weed outbreaks from 64 private property infestations were examined for the period 1982–2004. Aside from 12 records, all private property outbreaks were on farms.

RESULTS

Parthenium weed detections The minimum total number of parthenium weed plants that have been detected in NSW is 34,015 (Figure 1). This number represents 19,582 new plant detections and 14,433 detections from recurring sites.

The annual rate of detection of parthenium weed plants is just over 1200 plants each year (Figure 1), representing both new and recurring infestations. The largest yearly increase in the number of plants found was in 1990 when at least 5850 plants were found (75% from recurring infestations). During this year four large infestations of over 1000 plants each were found, three of which were recurring infestations on the one property.

The average annual rate above was halved during the period 1992–2002 and around 420 plants detected each year during the periods 1996–2002 and 2006–2009 (Figure 1). At least 87% of detections during these latter two periods were due to new plant infestations.

New parthenium infestations A total of 640 new parthenium weed infestations have been found in NSW since 1982 (Figure 2), compared with 151 recurring infestations. This represents an average of 23 new and 5 recurring infestations annually. The number of new infestations rose to peak at 86 in 1989 and since 1991 has not exceeded 35 sites, varying between 2 and 3 sites since 2007.

Seasonality of parthenium weed detections Over 60% of new and recurring infestations of parthenium weed were found in summer and a further 30% in autumn (Table 1). Detections in both winter and spring were relatively uncommon, with just over one per year.

Land use and outbreak source Nearly 70% of new and recurring infestations of parthenium weed were found in roadside corridors, the majority of which were on the Newell highway between Goodiwindi and Narrabri (Table 2). Of note is the small percentage of detections around wash down areas (4%). Water was not responsible for the small percentage of outbreaks along watercourses as these occurred under dry conditions (Table 2).

Aside from these areas, a large number of infestations were found on private property (192). The predominant farming enterprise was generally, but not always, dry land cereal production and/or grazing. An analysis of the probable source of outbreaks for 64 new infestations between 1982 and 2004 indicates that grain harvest machinery was the principal source (nearly 60%, Table 3). In fact, the most southern detection of the weed in NSW, near Deniliquin, was

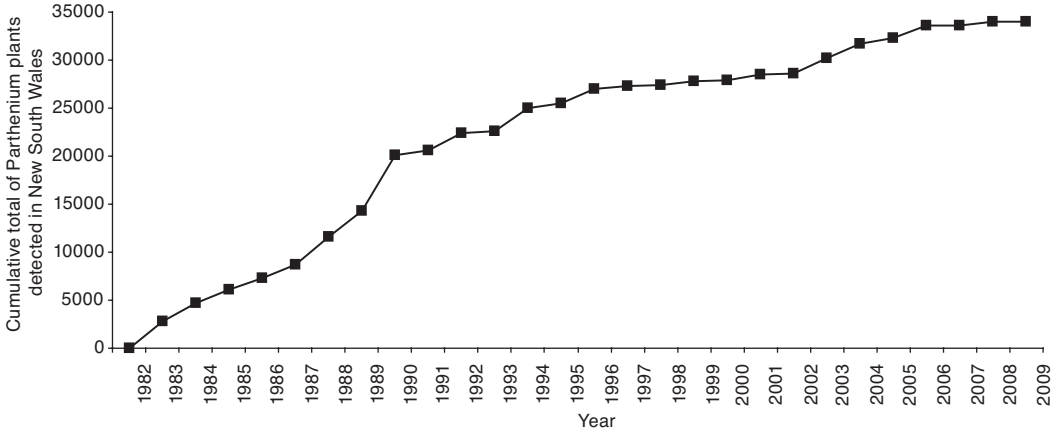

Figure 1. Minimum cumulative total of parthenium weed plants from new and recurring infestations recorded during the period 1982–2009 in NSW.

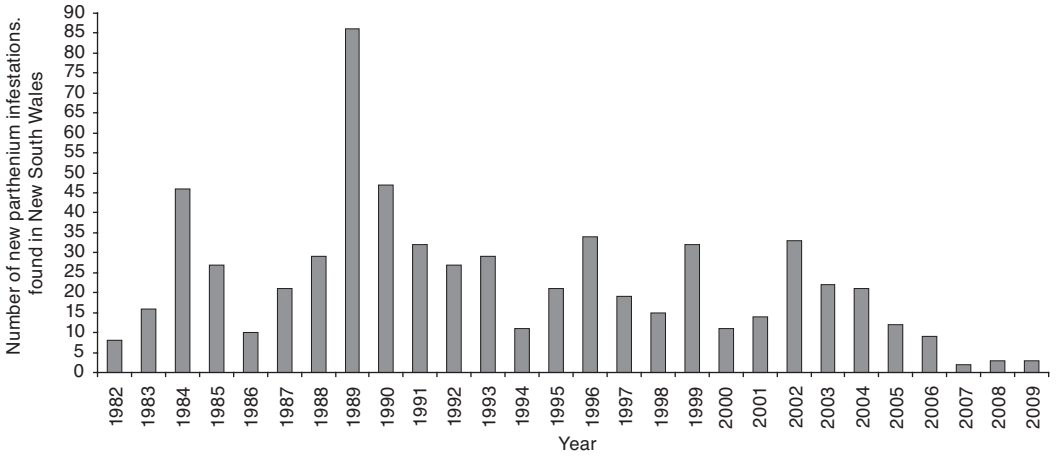

Figure 2. Number of new parthenium weed infestations recorded during the period 1982–2009 in NSW.

from an area where a header had been dismantled. Vehicles and other machinery (some of which would have been used in grain harvest) accounted for another 14% of outbreaks.

Of particular note is the significant role played by oilseed by-product transport (Table 3) attributed to the sale and distribution of contaminated sunflower hulls post-oil extraction as stock feed, particularly during the 1994 drought. With grain and seed movement (for cattle feed and cereal planting), contaminated stock feed represents a significant if minor means of dispersal. Having said this, hay contamination has only been linked to one outbreak (Table 3).

DISCUSSION

The eradication program targeting parthenium weed in NSW is successful. This conclusion is based on the continued low rate of new and recurring plant detections and the decreasing incidence of new plant infestations Over the 28 years since the first NSW outbreak was discovered, it has become apparent that the occurrence of outbreaks is directly related to the amount of propagules introduced to NSW from Queensland through human activity. No known new outbreaks in NSW have been caused by natural spread apart from the initial large outbreak north of Moree discovered in 1983. This outbreak appears to have been present for some years and had been partly spread to adjoining properties and roadsides by wind.

Several factors have led to the reduced introduction of propagules, for example the closure of an oilseed crushing plant in Moree in 2000. The capacity of this plant exceeded the local supply of sunflowers and in the 1980s and 1990s crushing sunflowers were sourced from central Qld. The central Qld sunflower

Table 1. Season that new and recurring infestations of parthenium weed infestations were detected in NSW from 1982–2009.

Season	Number	Percentage
Spring	36	4.6
Summer	478	61.5
Autumn	233	30.0
Winter	30	3.9
Total	777	100

Table 2. Recorded land use where new and recurring infestations of parthenium weed were detected in New South Wales from 1982–2009.

Land use	Number	Percentage
Roadside corridors	539	69.4
Wash down area	33	4.2
Watercourse (dry)	7	0.9
Other	6	0.8
Private property	192	24.2
Total	777	100

Table 3. Probable source of outbreaks of new parthenium weed infestations on private property detected in New South Wales from 1982–2004.

Outbreak source	Number	Percentage
Grain headers	38	59.4
Vehicles/trucks/other machinery	9	14.1
Oilseed by-product transport	6	9.3
Grain/seed	6	9.3
Hay	1	1.6
Do not know	4	6.3
Total	64	100

seed was contaminated with parthenium weed seed and it is believed that leakage from trucks travelling between Goondiwindi and Moree caused the majority of roadside outbreaks. The number of outbreaks along this stretch of highway has declined almost to zero since the closure of this plant.

Enhanced inspection and cleaning standards for grain harvesters entering NSW from Qld was legislated in 1997. Since that time outbreaks on private property have declined significantly. Hygiene practices for harvesting equipment and commercial vehicles leaving central Qld have also improved significantly since 2001 with the introduction of statutory vendor declarations in Qld for vehicles that may be carrying parthenium weed seed, litigation in NSW over an outbreak at Condobolin and the building of numerous public washdown facilities around core infestation areas. This work has been coordinated by the National Parthenium Weed Management Group and supported by grants from the Natural Heritage Trust.

The final factor influencing the introduction of propagules has been drought in Qld. Central Qld was in drought during 2000–2008. This has meant a lower number of parthenium weed plants and a smaller production of propagules as well as a much reduced central Qld wheat crop. Despite summer rainfall improving markedly from 2008 to present, winter rainfall has continued to be marginal for winter cereal production. This has meant a corresponding reduction in the seasonal movement of grain harvesting machinery, vehicles and grain from a peak in 1988.

Outbreaks on privately owned agricultural land are of a far more serious nature than those on roadsides. This is because the vast majority of roadside infestations contain fewer than five plants (80% of road side infestations), and often single plants (55% of roadside infestations) (data not presented). Infestations on private land are generally larger, are commonly not detected until large numbers of plants have reproduced (over several years at least) and result from machinery used in grain harvesting (headers) that are transported on other vehicles.

NSW can successfully fight the parthenium weed invasion as long as southern Qld remains relatively free from infestation. However, it is anticipated that parthenium weed may become established in southern Qld by 2020, but it is hoped that the biological control program will have reduced the vigour of the species by that time (R McFadyen pers. comm.). Continuing outbreaks in southern Qld are not an immediate threat to NSW. However, should parthenium weed be permitted to become established in southern Qld before the biocontrol program has been demonstrated to be successful, the threat to NSW may be dire.

SOME LESSONS LEARNT

1. Any eradication campaign will need to be continuous if immigrant propagules pressure can not be totally removed.
2. Knowledge of potential weed threats may be gleaned from adjoining jurisdictions (formal communication processes need to facilitate this).
3. Eradication attempts need to be started early.
4. Summer and autumn have been the most common seasons in which to detect parthenium weed plants, while roadside corridors are the most common places where plants are found.
5. Machinery used in cereal grain harvesting, followed by other vehicles, is the most common means of dispersal. Continued inspection and cleaning of this equipment is needed before 'clean areas' are entered.
6. Attention is also needed in wash down areas, and for grain/seed lots to reduce new plant incursions.
7. Parthenium weed seed can remain viable for at least 21 years (P. Welchman pers. comm.). Repeated inspections and management of previously seeded infestations are needed.
8. Inspection and cleaning standards, legislation and community awareness all have a part to play in maintaining vigilance against parthenium weed.
9. Thorough and regular farm inspections continue to be needed.

ACKNOWLEDGMENTS

Alan Maguire, Industry and Investment NSW, Tamworth, kindly collated much of the data for this paper. We recognise the outstanding efforts of many current and previous local government weed officers, and departmental staff who have participated in the ongoing detection and eradication of parthenium weed from NSW. We thank the referees for their helpful comments.

REFERENCES

Blackmore, P.J. (1997). Parthenium weed update. Proceedings of the 9th Biennial Noxious Weeds Conference, pp. 18-23. (NSW DPI, Dubbo).

Chamberlain, J. and Gittens, A. (2003). Parthenium weed management. Queensland Department of Natural Resources, Mines and Energy, Brisbane.

Navie, S.C., McFadyen, R.E., Panetta, F.D. and Adkins, S.W. (1996). The Biology of Australian Weeds 27. *Parthenium hysterophorus* L. *Plant Protection Quarterly* 11, 76-88.

Parsons, W.T. and Cuthbertson, E.G. (2001). 'Noxious weeds of Australia', 2nd ed. (CSIRO Publishing).

Weeds Australia (2010). Parthenium National Management Map. Online at www.weeds.org.au/WoNS/parthenium/ (accessed 18 May 2010).